USC UNIVERSITY OF SOUTHERN CALIFORNIA | IMSC Integrated Media Systems Center

INTEGRATED MEDIA SYSTEMS CENTER
A National Science Foundation
Engineering Research Center
UNIVERSITY OF SOUTHERN CALIFORNIA

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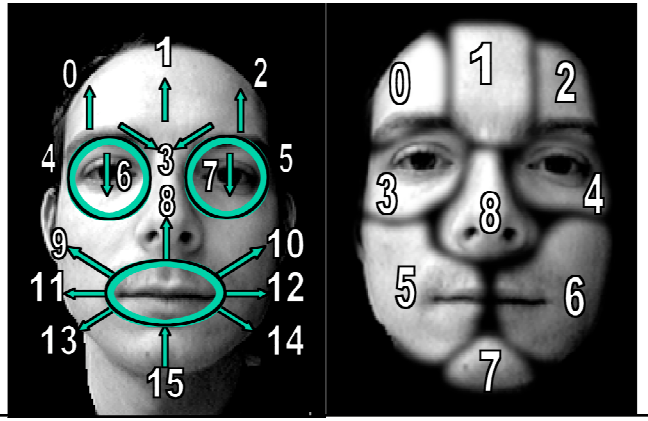
FACIAL ANALYSIS AND APPLICATIONS

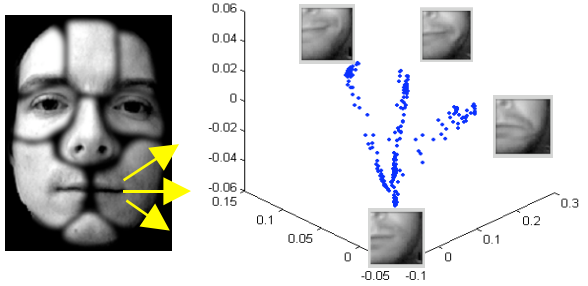
0. Frontalis L
1. Frontalis C
2. Frontalis R
3. Corrugator
4. Orbicularis Occuli L
5. Orbicularis Occuli R
6. Levator Palpebrae L
7. Levator Palpebrae R
8. Levator Nasii
9. Zygomatic Major L
10. Zygomatic Major R
11. Risorius L
12. Risorius R
13. Triangularis L
14. Triangularis R
15. Mentalis



CR	Muscles
0	0
1	1, 3
2	2
3	4, 6
4	5, 7
5	9, 11, 13
6	10, 12, 14
7	15
8	8

Facial muscle activations estimated in local coarticulation (CoArt) regions

Flipbook style animation driven by CoArt analysis.



Gesture trajectories traced out by contraction of 3 independent muscles in the lower mouth region.

USC STUDENTS, DEGREES

Douglas Fidaleo, Zhenyao Mo (Ph.D. students)

OTHER RESEARCHERS, AFFILIATIONS

BRIEF DESCRIPTION OF DEMONSTRATION

Facial motion is decomposed into nine regions of potential change called *co-articulation regions*. These co-articulation regions are analyzed to produce abstract muscle activations and low dimensional *gesture polynomial* representations over time. The result is a general analysis framework amenable to a wide variety of uses, from expression recognition to facial animation.

Feature points on a trained database of faces are labeled, producing a shape+texture statistical appearance model. The information in this model is explored in novel ways to extrapolate missing regions of faces and automatically produce caricatures.

DISTINGUISHING CHARACTERISTICS RELATIVE TO STATE-OF-THE-ART

The fact that face-to-face meetings remain important in this age of ubiquitous cell phones is indication that non-speech gestures are important. Computer analysis of speech is the subject of extensive research, but non-speech facial gestures have received less attention. Our mid-level analysis of the textural appearance of co-articulation regions appears to be a unique approach to this problem.

Extrapolation of faces at the pixel level (super-resolution) and by interpolating grids of sample points have been demonstrated previously, but we believe our extrapolation of entire regions of dense pixels appears to be a first.

UNDERLYING TECHNOLOGIES

- Principal component analysis
- Independent component analysis
- Gesture polynomial reduction
- Combined shape+texture statistical appearance modeling

APPLICATIONS

Natural human-machine communication will require the development of a computational facility with facial gestures. Statistical modeling of facial proportions has possible applications in security, medicine, and entertainment. Partially obscured photographs of a person of potential interest can be extrapolated with an objective "best guess" given the statistics of a given population. Statistical face extrapolation can provide guidance for reconstructive surgery correction of congenital facial deformations.

RECENT HIGHLIGHTS, LEVEL OF DEVELOPMENT, UPCOMING MILESTONES

Gesture Polynomial Reduction (GPR), developed in the last year, provides a concise and continuous model for expression space at the region level. The GPR representation was originally explored for person specific facial analysis; multi-individual generalization trials are now being undertaken.

The obscured mouth region is guessed from population statistics

Automated caricature by exaggerating features that exceed population standard deviation.

LIST OF PUBLICATIONS, REFERENCES, URLs

- D. Fidaleo and U. Neumann, Analysis of Coarticulation Regions for Performance Driven Facial Animation, *Journal of Visualization and Computer Animation*, 2003.
- J-Y. Noh, D. Fidaleo, U. Neumann, Gesture Driven Facial Animation, USC Technical Report 02-761, 2002.
- D. Fidaleo and U. Neumann, CoArt: Co-Articulation Region Analysis for Control of 2D/3D Characters, *Computer Animation* 2002.
- D. Fidaleo, J-Y. Noh, T-Y Kim, R. Enciso, and U. Neumann, Classification and Volume Morphing for Performance-Driven Facial Animation, Proceedings Digital and Computational Video 1999.

http://graphics.usc.edu (CGIT lab web pages)

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